

1922
N 63

AN INVESTIGATION ON THE PRODUCTION OF LEAD
ARSENATE BY ELECTROLYTIC METHOD

BY

ARATA LEO NITTA

THESIS

FOR THE

DEGREE OF BACHELOR OF SCIENCE

IN CHEMISTRY

COLLEGE OF LIBERAL ARTS AND SCIENCES

UNIVERSITY OF ILLINOIS

1922

1926
N63

UNIVERSITY OF ILLINOIS

.....1.....191

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

.....

ENTITLED.....

.....

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF.....

.....

W. S. Putnam


Instructor in Charge

APPROVED :.....*W. A. Noyes*.....

HEAD OF DEPARTMENT OF.....*Chemistry*.....

ACKNOWLEDGMENT

To Professor Lutrum, under whose direction this investigation was carried out, the writer wishes to express his gratitude for many valuable suggestions and kind guidance. Thanks are also due Dr. Dietricson, who by furnishing necessary apparatus, has made the laboratory work possible.



Digitized by the Internet Archive
in 2015

<https://archive.org/details/investigationonp00nitt>

Table of Contents.

1924

Introduction	1.
a. Importance of insecticide industry--	2.
b. Classes of insects and insecticides--	4.
Historical.	
a. Origin of use of insecticides in U. S.--	5.
b. Early steps of introduction of DDT--	6.
c. Initial insecticide industry--	6.
Chemical composition of commercial DDT--	6.
d. Government specifications--	8.
Present success of manufacture of DDT in America and its raw materials.	6.
Experiment 19.	10.
e. Application of DDT--	10.
Conclusion.	11.

INTRODUCTION.

The electrolytic process is a recent advancement in the manufacture of various pigments and some chemicals.

References:-

"The Manufacture of Chemicals by Electrolysis" by L. S. Hile.

"Electrolytic production of white lead, cadmium yellow, of mercury vermillion, of Scheele's green, and of Berlin blue," in "Experimental Electrochemistry" by Hopkins, pp. 122-152.

Several patents have been granted on the manufacture of white lead by electrolysis.

U. S. 644,776 (1900) by Luckow.

"An Electrolytic Process for Manufacture of White Lead", by H. L. Williams, J. Am. Chem. Soc. (1905), p. 138.

"Process of Manuf. Lead Salts by Electrolysis" U. S. 670,431 (1901) by J. B. Hibbits.

"Method of Manuf. of Lead Salts by Electrolysis" U. S. 1,308,948 by H. M. Harrington (1919).

"White Lead by Electrolysis" by H. L. Brown.
U. S. 1,290,103 and 1,293,555.

and several others.

It is claimed that the electrolytic production of white lead has great advantages over the old processes of Dutch, of French, or the Germans.

Why then the similar process can not be applied on the production of lead acetate?

The investigation involves technical process based upon the chemical theories and the whole success moreover depends upon the economical standpoint of the manufacturing. In attacking the problem it is well, however, at the first hand to consider the successful production of lead acetate without considering all the economical factors involved. After finding the favorable conditions of its manufacture the economic features, such as the cost of raw materials, amount of energy to be consumed, the cost of labor for the production, and the conditions should be considered.

The sphere of the work is wide and it requires a profound knowledge of electrochemistry coupled with an ability in doing researches.

As yet it is only a preliminary survey on the subject and I leave this work unto the promising electro-chemist, who may happen to bump on this stumbling block in some future days.

The main influencing conditions on the process to be investigated are the following:-

1. Nature of the electrolyte.
2. Concentration of electrolyte used.
3. Temperature influence upon which the process

1. 0. 5. 1.

2. Suitable material is used in the electrolyte.
3. With the electrolyte used the current density.
4. Inhomogeneous electrode potential.
5. Specific gravity of electrolyte before and after the electrolysis.
6. Nature of the products obtained.
7. Economical investigation of the process, etc.

11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840. 841. 842. 843. 844. 845. 846. 847

U.S. 245, 11 (1907)

and finally came out as a commercial product.

Chem. Abstr. Eng. 22, (1921) 1. 351.

In 1909, W. W. Luther and W. L. Volck, of San Francisco, California, got into a patent on the manufacture of lead arsenate by mixing arsenic acid and litharge.

U. S. 919,905, Aug. 2, 1909.

The mixture was roasted in presence of oxygen assisted by oxidizing agent. Lead arsenite, formed at the early stage, is oxidized into arsenate. Since that time more than a dozen patents are taken out on the subject.

Approximate chemical composition of commercial arsenate.

There are several kinds of lead arsenate possible. The original product was what is known as a triplumbic arsenate of lead, $Pb_3(AsO_4)_2$.

Theoretically it contains

74.42 percent of Pb O.

25.58 " " As_2O_3

The other is orthoplumbic arsenate, which contains theoretically

64.20 percent of Pb O

35.80 " " As_2O_3

2.00 " " PbO

J. Am. Chem. Soc. (1919) 1. 1685.

The commercial lead arsenate is a mixture of the above two forms in different proportions, and this variation in the proportion due to the different methods of preparations.

The value of the insecticide is determined by the amount of arsenic in the compound; and some of the best grade contain up to 50 per cent of arsenic oxide.

GOVERNMENT SPECIFICATION.

By the Insecticide and Fungicide Act of 1910, the paste form of lead arsenate should not contain more than 50 percent of water. It should contain at least $12 \frac{1}{2}$ per cent of arsenic oxide, and less than $\frac{3}{4}$ of one percent of arsenic oxide in water soluble form.

Chem. Age, (1921) 32, no. 7, p. 557.

PRESENT METHODS OF MANUFACTURE OF ARSENATE AND LEAD ARSENATE.

The larger part, probably more than three fourths of the arsenate of lead, produced in this country, is made by the interaction of arsenic acid and litharge.

There are two distinct methods of manufacturing:- one being a wet process and the other, which is rather a recent invention, being dry method.

Dry Methods:-

U. S. 1,344,035 (1920) by C. L. Hedenburg and D. W. Pratt.

U. S. 1,173,565 by L. Shepherd, (1916)

J. Ind. and Eng. Chem. 14, (1921) p. 351.

The raw materials commonly used, due to the cheapness are litharge and white arsenic. Some processes, however, claim certain advantages in using lead nitrate, white lead, lead peroxide, and lead acetate.

Current Quotations on Prices of Raw Materials Used.

| | | |
|------------------|----------------------------|---------------------------|
| Litharge per lb. | by carlot
C.07 1/2--.08 | less carlot
.061/2-.09 |
| White arsenic " | .06--.061/4 | .06 1/2--.07 |
| Lead nitrate " | . ---- | .15---.20 |
| Lead acetate " | ----- | .10 5/8--.12 1/2 |

| | | |
|-----------------------------|--------------|--------------|
| Lead arsenate (paste) " | .09--.09 1/2 | .010---.0.11 |
| Lead arsenate " (in powder) | .06 1/2--.07 | .07 1/2-.08 |
| Sodium nitrate' | .025 | .026 |

Chem. Met. Eng. Sept. 1921.

Sodium arsenate per lb. C.70

Quoted from price list of Mallinckrodt Chemical Works (1921)

Sodium arsenate C. 1. per lb. 40.50

J. D. Baker Chemical Company.

Apparatus used.

Apparatus used, -

Ampmeter--Weston direct reading ampmeter, having
reading of 15 amperes.

Rheostat--Carbon rheostat.

Voltmeter--Weston direct current voltmeter having
5 and 15 volts of reading.

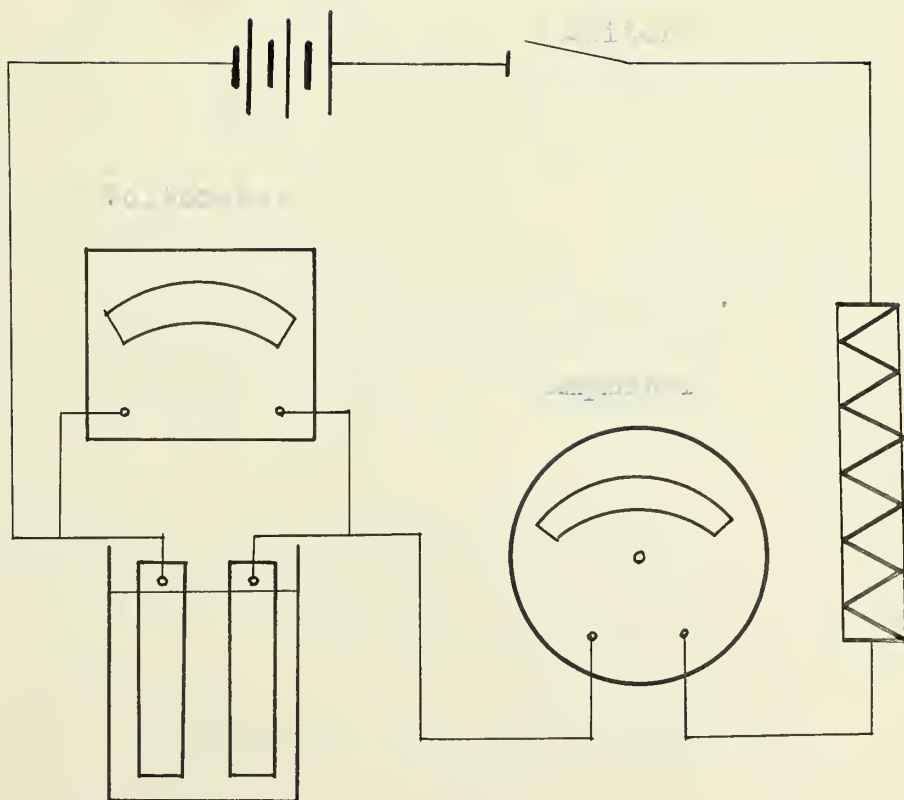
Electrodes used--Carbon, iron, lead, and copper.

Cell jar-- One liter beaker is used.

Diaphragm-- A porous porcelain cup.

Source of electricity--from 110 volt direct current.

Diagram of apparatus.



EXPERIMENT 1.

The first experiment based upon the theory of precipitation of insoluble lead arsenate in contact with arsenate ion from soluble arsenate salts with lead ion electrolytically set free from the lead anode. The commonly known salts such as sodium arsenate and sodium biarsenate are tried.

The different kinds and different concentrations of electrolytes, various electrodes, and the effects upon the precipitation with various current densities were tested.

The following experiments were performed under fixed conditions only varying the electrolyte and its concentrations.

The fixed conditions are

Electrodes,--Cathode, - Cu plate whose area being 1.7 dm. sq.

Anode,--Pt. plate whose area being 2.6 dm. sq.

Current Density,-- 0.5 amp. per sq. dm.

Temperature,-- At room temperature.

Duration of run,-- 30 minutes,

Experiment 1.

Electrode used,-- sodium biarsenate.

Concentration,-- 5 per cent solution.

Observation,--

hydrogen gas from the cathode.

oxygen from the anode.

no precipitate was obtained.

Experiment 2.

Electrode used,- Sodium arsenate.

Concentration,- 5 per cent solution.

Observation ,-

Evolution of the gases as in the preceding exp.

no precipitation was obtained.

Experiment 3.

Electrolyte used,- Sodium biarsenate.

Concentration,- 10 per cent solution.

Observation.-

Same as the proceedings.

Experiment 4.

Electrolyte used,- Sodium arsenate.

Concentration,- 10 per cent solution.

Observation,- Same as the proceedings.

The Effect of Secondary Salts.

The effect of the presence of secondary salt in the electrolyte was tested, as it was suggested by C. F. Carrier. He successfully used sodium chlorate or sodium acetate in the preparation of white lead from sodium carbonate solution with lead anode.

J. Phys. Chem. (1909) 13, pp.256 and 312.

Trans. Am. Electro. Chem. Soc. (1904) p. 229.

U. S. 641, 779 by Richard and Koepfer.

Experiment 5.

Electrolyte used,-

50 parts of 5 per cent of sodium arsenate.

50 " " " " sodium chloride.

Observation,-

Gases from the both electrodes.

No sign of precipitation.

Experiment 6.

Electrolyte used,-

50 parts of 5 per cent of sodium acetate.

50 " " " " sodium arsenate.

Observation,-

Same as the preceding.

Experiment 7,

Electrolyte used,-

50 parts of 5 per cent of sodium arsenate.

40 " " " " sodium acetate.

40 " " " " sodium chloride.

Observation,-

Same as the preceding.

Summary of Experiment Series 1.

| exp. | Electrolyte. | Concent. | Observation. | Precipitation. |
|------|--|-----------|-----------------------------------|----------------|
| 1 | $\text{Na}_2\text{H As O}_4$ | 5% sol. | Gases evolut.
from electrodes. | no. |
| 2. | $\text{Na}_3\text{As O}_4$ | 5 % sol. | " | " |
| 3. | $\text{Na}_2\text{H AsO}_4$ | 10 % sol. | " | " |
| 4. | $\text{Na}_3\text{As O}_4$ | 10 % sol. | " | " |
| 5. | 50 parts of $\text{Na}_3\text{As O}_4$ | 5 %. | " | " |
| | 50 " " NaCl O_3 | 5 %. | " | " |
| 6. | 50 parts of $\text{Na}_3\text{As O}_4$ | 5 %. | " | " |
| | 50 " " Na COOH | 5 %, | " | " |
| 7. | 20 pts. of $\text{Na}_3\text{As O}_4$ | 5 % | " | " |
| | 40 " " Na COOH | " | " | " |
| | 40 " " Na ClO_3 | " | " | " |

Experiment 2.

The conditions being the same, the effect on various concentrations of electrolyte was tested.

Experiment 1.

Electrolyte, -500 CC. Of 1% of Na_3AsO_4 sol.

Observation, -

The gases from the both electrodes.

No precipitation.

Experiment 2.

After 15 minutes of electrolysis of the experiment 1, 5 grams of sodium arsenate is added.

The observation and the results are the same.

Experiment 3.

After 15 minutes of electrolysis of experiment 2, 5 grams of sodium arsenate is added.

Observation, - No precipitation, but slightly cloudy.

Experiment 4.

The filtrate of the experiment # 3 is electrolyzed for 15 minutes after addition of 5 grams of sodium arsenate.

Observation, - became very much cloudy.

Weight of the precipitate obtained 0.1042 gm.

Experiment 5.

After 15 minutes of electrolysis of experiment 4, filtered. To filtrate 5 grams of sodium arsenate is added, and electrolyzed.

Observation, - No precipitation.

Experiment 6.

After 15 minutes of electrolysis, 10 grams of sodium arsenate is added.

No precipitation.

Experiment 7.

After 15 minutes of electrolysis, 15 grams of sodium arsenate is added.

No changes from the preceding experiment was observed.

Summary for the experiment series 2.

The small amount of precipitation was obtained in experiment 3 and 4, whose concentrations are 3 and 4 respectively.

EXPERIMENT SERIES 3.

The effect of the varying proportion and the concentrations of the electrolyte and of the secondary salts is determined.

The fixed conditions are the same with series 1 experiment.

The quantity of electrolyte taken in each experiment is 500 CC.

The electrolyte was kept in acidic condition with nitric acid and indicator, in order to prevent the formation of basic lead salt.

Air is bubbled through the electrolyte in order to stir the precipitates formed.

Experiment 1.

Electrolyte,- 2pts of 5% of sodium arsenate.
5 " " 5 " " potassium chlorate.

Observation,-

Voltage drop,-5.0 v. initial, 6.5 v. final.

Hydrogen gas from the cathode and precipitates clinging to the anode.

Weight of precipitate obtained after 30 minutes of run, 2.3850 gm.

Experiment 2.

Electrolyte,- 2 pts. of 6% of sodium arsenate.
5 " " 5 " " potassium chlorate.

ate.

Voltage drop, - initial 3.8 v. final 5.2 v.

Wt. of precipitation obtained, 3.7825 gm.

Experiment 5.

Electrolyte, - 2 pts. of 10 % sol. of sodium arsenate.
3 " " 5 " " "K-chlorate.

Voltage drop, - initial 4.7 V. final 5.8 v.

Weight of precipitation, 2.7572 gm.

Experiment 4. Changing the concentration of K-chlorate.

Electrolyte, - (2 pts. of 5% of K-chlorate.
(3 " " 5 " " " sodium arsenate.

Voltage drop, - initial 7.0 v. final 7.9 v.

Weight of precipitate obtained, 2.0876 gm.

Experiment 5.

Electrolyte, - (2 pts. of 6 % of K-chlorate.
(3 " " 5 " " " sodium arsenate.

Initial voltage drop, 4.9 v. , final 5.5 v.

Weight of precipitate obtained, 2.2564 gm.

Experiment 6.

Electrolyte, - (2 pts. of 10 % of K-chlorate.
(5 " " 5 " " " sodium arsenate.

Initial voltage drop 4.9 v., final 5.5 v.

Weight of precipitate obtained 2.3605 gm.

Experiment 7. Increasing amount of K-chlorate.

Electrolyte, - (3pts. of 10 % of K-chlorate.
(2 " " 5 " " sodium arsenate.

Voltage drop, initial 8.2 v., final 8.6 v.

Weight of precipitation obtained 3.6342 gm.

Experiment 8.

Electrolyte (4 pts. of 10 % of K-chlorate sol.
(1 " " 5 " " sodium arsenate.

Voltage drop, - initial 2.6 v. , final 3.6 v.

Weight of precipitate 1.3582 gm.

SUMMARY FOR THE EXPERIMENT SERIES #3.

| Exp. | Electro-
lyte. | Conc. | Proport. | Voltage drop.
init. | final. | Wt. of ppt. |
|------|--|-------------|---------------|------------------------|--------|-------------|
| 1. | (Na_3AsO_4
(KClO_3 | 3 %
5 " | 2 pts.
3 " | 5.0 | 6.3 | 2.3820 gm. |
| 2. | (Na_3AsO_4
(KClO_3 | 6 %
5 " | 2 pts.
3 " | 5.8 | 5.2 | 3.7825 " |
| 3. | (Na_3AsO_4
(KClO_3 | 10 %
5 " | 2 pts.
5 " | 4.7 | 5.6 | 2.7572 " |
| 4. | (KClO_3
(Na_3AsO_4 | 3 %
5 " | 2 "
3 " | 7.0 | 7.9 | 2.6876 " |
| 5. | (KClO_3
(Na_3AsO_4 | 6 %
5 " | 2 pts.
3 " | 4.7 | 5.3 | 2.2564 " |
| 6. | (KClO_3
(Na_3AsO_4 | 10 %
5 " | 2 pts.
3 " | 4.9 | 5.5 | 2.3605 " |
| 7. | (KClO_3
(Na_3AsO_4 | 10 %
5 " | 3 pts.
2 " | 8.2 | 8.6 | 3.6342 " |
| 8. | (KClO_3 | 10 % | 4 pts. | 2.6 | 3.6 | 1.3582 " |

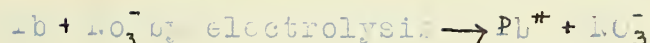
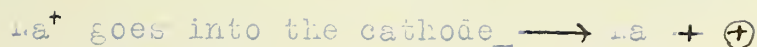
EXPERIMENT SERIES 4.

The experiment was done , using the method of Vreeland's patent.

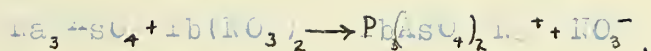
U. S. 870,915 (1908)

He used a cathode of iron in a solution of alkaliine hydroxide contained in a porous receptacle, which in turn was placed in a vessel containing an anode of lead and a solution of a salt which when electrolyzed will produce a soluble lead salt. Lead arsenate is formed by means of a soluble salt of arsenic.

The reactions involves in the reactions are



To the above solution sodium arsenate is added.



This sodium and nitrate are again used as anode solution in the next operation. This process, therefore, is simply the electrolytic production of lead nitrate.

The conditions fixed for the experiment are

Electrolyte, - $NaNO_3$ in anode and $NaOH$ in cathode compartments.

Concentration, - 5 per cent solution of each.

Electrodes, - (Anode, - Pb plate whose area
(5.0 sq. dm.

(Cathode, - Iron bar whose area 0.7
sq. dm.

Current density, - 0.8 amp. per sq. cm.

Duration of run, - 30 minutes.

After the run in each experiment, 10 percent solution of sodium arsenate is added until the solution is saturated and the solution is filtered, the precipitate then dried and weighed.

Experiment 1.

500 cc of 5 percent of sodium nitrate solution is taken.

Weight of precipitate obtained--7.2167 gm.

Experiment 2.

The filtrate from the experiment 1 is again electrolyzed for 30 minutes, and saturated with sodium arsenate, the precipitate was filtered and weighed.

Weight of ppt.-- 10.1765 gm.

Experiment 3.

The filtrate of experiment 2 is electrolyzed, and the precipitate is weighed.

Weight of precipitate--10.6362 gm.

SUMMARY.

The process was indefinitely continued by addition of sodium arsenate, the weights of precipitate obtained are 7.2167 gm. , 10.1765 gm., and 10.6362 gm. respectively.

Experiment 5.

The above various cathodes was examined.

The fixed conditions are

Electrolyte, - 5 per cent of sodium arsenate.

Current Density, - 0.3 amp. sq. cm.

Duration of run, - 30 minutes.

Experiment 1.

Electrode used, - Lead cathode having area of 2.2 sq. cm.

Voltage drop, - initial 0.8 v., final 0.8 v.

Weight of precipitate, - 1.8220 gm.

Experiment 2.

Electrode, - Carbon whole solution area 0.75 sq. cm.

Electrode potential, - initial 0.8, final 0.8 v.

Weight of precipitate, - 0.7880 gm.

Experiment 3.

Electrolyte, - Copper sulfate whole area 1.7 sq. cm.

Electrode potential, - initial 0.8, final 0.8 v.

Weight of precipitate, - 1.0940 gm.

Experiment 4.

Electrode, - Iron plate whole electrode area 0.7

0.7 sq. cm.

Electrode potential, - initial 10.0 v. final 10.0 v.

weight of precipitate obtained, - 1.8850 gm.

SUMMARY OF RESULTS 5.

Carbon electrode gave the best yield and deposition
high value under the given condition. Iron and lead
have very low value.

CONCLUSIONS.

1. Influence of different electrolytes on the precipitation.

Under the same condition, by changing electrolyte, various precipitates are obtained. (See Table I. the experiment series 6).

2. Effect of change concentration of electrolyte.

There is an optimum concentration for the precipitation under each condition. The conditions may include current density, various cathodes, nature of electrolyte, temperature of the bath and some others.

Under the same condition of experiment series 3, the concentration of 1 or 4 percent was found as the best suited.

3. Influence of the secondary salts.

As to the possible explanation of the function of secondary salt presented,

- a. The presence of the secondary salt increases the conductivity of the electrolyte.

- b. This is, then, an acceleration effect of lead going into the ionic form.

- c. The ionized lead will, finally, take part in the precipitation as double lead carbonate.

d. This conveniently increases the diaphragm area and reduces the amount of material used.

e. As indicated, the economy of it, therefore, should be highly desirable.

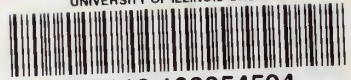
4. The use of soluble salts of arsenic.

In the trial process the use of soluble salt of arsenic is found to be impossible, owing to the high cost of arsenate salt. By this very section Vissler, the inventor of electrolytic method, has proposed the use of other process, which use cheaper raw material for the manufacture of less arsenate salt into electrodes.

As indicated previously, this is an interesting subject. The reason for this is that the cost of the material used is a very important factor in the process.

The use of cheaper raw material, as the salt of arsenic, is also, of course, of great importance, as the cost of the material used is a very important factor in the process. At this point, it may be said that the use of electrolytic method of producing arsenic is not possible. On the other hand, it is possible to produce electric current from other sources, and these are also of great importance. It is also possible to produce electric current from other sources, and these are also of great importance. It is also possible to produce electric current from other sources, and these are also of great importance.

UNIVERSITY OF ILLINOIS-URBANA



3 0112 108854594